



United States
Department of
Agriculture

Forest Service

NA

MFO

Reply to: 3460 Technical Assistance

Date: January 12, 1983

Subject: Tuliptree Scale Damage Assessment and Timber Impacts - Brownstown and Tell. City Ranger Districts

To: Forest Supervisor Wayne-
Hoosier NF

During 1982, the FPM staff here in Morgantown, West Virginia, surveyed the host condition in 7 yellow-poplar plantations where the tuliptree scale, Toumeyella liriodendri (Gemlin), had been detected by district personnel. In several of the plantations scale populations had reached outbreak densities and caused enough damage to seriously threaten timber management there. As a consequence, we provided technical assistance and funding to the TM Staff at the Brownstown Ranger District to suppress populations during FY 1982 and will again support their suppression in FY 1983 and extend our support to the Tell City Ranger District against this pest.

Our involvement with the Brownstown Ranger District pointed up the lack of information about the incidence of host damage caused by this pest and its resultant timber impact. While NEFES had determined that the insect caused tree mortality, height growth loss and poor form, we knew of no survey results, let alone procedures which contributed basic data about the relative frequency of these damage types nor their importance to tree survival and growth. In the short-term, such data would strengthen any economic evaluation for suppression, while in the long-term, it could be used to establish a damage threshold above which suppression would be needed. Additionally, Forest Pest Management could use the procedures to determine when and where damage reaches this threshold.

Consequently, we designed a survey to collect data on host tree and stand conditions which would allow an appraisal of timber impacts. The enclosed report presents our procedures and preliminary results. We plan to collect more data in conjunction with future biological evaluations.

We solicit your comments on this report and any suggestions on how forest pest management in yellow-poplar plantations might be improved through use of the results.

By copy of this memo, we are sending the report to the District Rangers affected, Phil Marshall, our Indiana State Forest Pest Management Cooperator, and Dave Donley of NEFES, Delaware, Ohio.

A handwritten signature in cursive script, reading "Allan T Bullard".

ALLAN T. BULLARD
Field Representative Forest Pest
Management

Enclosure

cc: A0, w/enclosure
Brownstown RD, w/enclosure
Tell City RD, w/enclosure
Phil Marshall, w/enclosure
Dave Donley, w/enclosure

- Preliminary Results -

Tuliptree Scale Damage Assessment and Timber Impacts Brownstown and Tell City
Ranger Districts Wayne-Hoosier National Forest
Indiana

by

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SUMMARY

Tuliptree scale was only one factor influencing host tree survival in seven, young (< 15 years) yellow-poplar plantations surveyed on the Wayne-Hoosier National Forest, Indiana, in 1982. Site limiting factors and mechanical planting damage combined with the scale to kill more than one-third of the original stems planted, on the average. The tuliptree scale had its greatest influence through height growth reduction (nearly half of the site's capability) by reducing host vigor for an average of 24 percent of the, ... residuals and by causing stem deformities on about 83 percent of all trees. Trees with forked tops were most frequently seen (about 35 percent) and these were invariably half as tall as normal trees.

INTRODUCTION

During 1981, the tuliptree scale, Toumeyella liriodeudri (Gemlin), reached outbreak densities in numerous yellow-poplar plantings on the Brownstown and Tell City Range Districts, Wayne-Hoosier National Forest, Indiana. This outbreak almost certainly represented the culmination of a population build-up over the last several years. The noticeable damage to many plantation trees caused TM staff personnel on both Ranger Districts and at the SO to contact FPM-MFO for technical assistance on what actions could be taken to alleviate the problem.

A biological evaluation for the tuliptree scale was made in selected plantations on the Brownstown Ranger District in August 1981 by Larry Yarger. Based on the data gathered regarding scale populations, a suppression project, involving the application of a dormant oil insecticide, was conducted in the spring of 1982. Late summer post-treatment population surveys showed that this material had been effective. Subsequent evaluations in additional plantations have lead to plans to treat other areas in 1983.

While population surveys have become routine, host tree and stand condition surveys are generally lacking such that information about host damage was virtually unknown. To resolve this inequity, pre-treatment damage assessment

surveys were made in every plantation evaluated for scale populations during 1982. These surveys were designed to collect basic data on host damage from the scale and the impact of this on timber. Such data will be used to improve management of this pest, especially economic consequences of suppression actions.

FIELD PROCEDURES

Plantation Selection

Seven yellow-poplar plantations, ranging in age from 8 to 14 years, were selected for survey because the TM staff observed tuliptree scale populations causing noticeable damage in each.

Survey Design

Each plantation was surveyed by a 2-person crew at the percent intensity shown in Table 1 using strip plots centered on the plantation rows. Each strip plot was one-tenth acre (0.125 x 8 chains or 8.25 x 528 feet) or less. The number of plots per plantation equaled the surveyed acreage divided by one-tenth. Plots were systematically distributed through the plantation. Since trees were planted in the rows at six foot intervals with eight feet between rows, the number of planting sites sampled equaled 88 per plot.

Observations and Measurements

At six foot intervals from the start of each plot, the following information was taken for each tree or original planting site for trees which have died: tree number, status, crooks, forks, bush, Vigor and height. These data were recorded for each strip plot within each stand. -),?

The tallest thirty yellow-poplar trees in the plantation were measured as total height to the nearest half foot and recorded. Some of these may already have been recorded. This provided a measure of the height growth potential for the site.

Definitions

The observation and measurement terms were defined as follows:

Tree Number - Consecutive number with the plot beginning with 1.

Status - Coded as L = live, D = dead, M = missing; for the latter two categories go on to the next tree.

Crooks - Trees with a dead terminal at sometime in the past which could be still present or missing, but only a single terminal expressing apical dominance now; count number which occur at ground line and above ground and record each of those numbers.

- Forks - Trees with single stem at ground line, but with two or more laterals forming multiple tops with all these expressing apical dominance; count number of laterals and record.
- Bush - Trees with two or more stems at ground line any one or all of which have assumed apical dominance; count number of stems and record.
- Low Vigor - Trees with dead, lower branches blackened from sooty mold and thin upper branches comprising a majority of the total branches; observe and record as 0 = NO or 1 = YES.
- Total Height - Height to tallest live terminal; measure to the nearest half foot and record.

RESULTS AND DISCUSSION

Characteristics of Yellow-Poplar Plantations

The 1982 survey revealed that current tree densities in the 7 plantations ranged from 47 to 95 percent of what was planted; the average density was about 61 percent (Table 2). Tree height for those trees sampled was consistently below that of the tallest trees in the stand. In the worst stand, sample tree height averaged only about one-third of the tallest; in the best stand they averaged about two-thirds. Considering all stands, sample tree height averaged about 48 percent of the site potential.

Typically then, yellow-poplar plantations 8 to 14 years old have experienced tree mortality exceeding one-third of the stems and height growth loss on the residual stems of nearly half what the site is capable. From observation, site limiting factors, such as high water table and competing grasses and forbs, as well as mechanical damage during planting, probably contributed greatly to the tree mortality, but had a lesser influence on loss in height growth. Without continuous annual measurements of photosynthate removed by the tuliptree scale from any given tree, it would be difficult to determine exactly how much this pest contributed to the demise and stunting of its host. A more general and practical approach to understanding this negative contribution was made by examining present tree conditions and deformity, since these represent the results of past scale feeding. ,

Tree Conditions

Table 3 presents data on tree status for all 1,138 planting sites sampled. Disregarding planting sites with dead or missing trees, it is apparent that tree vigor varies widely between plantations. However, the composite averages revealed that high density tuliptree scale populations (those causing low vigor) were prevalent on about 24 percent of all residual trees. Thus, almost 1 tree in 4 currently had scale populations which could cause mortality or further height growth loss because of deformities. The occurrence of deformities and their influence on height growth loss were examined.

Frequency of Deformities

A total of 621 trees were examined for deformities (Table 4). Only 16.7 percent of all trees were categorized as normal, i.e., without any deformities. Most trees (31.1 percent) had a combination of 2 types of deformities; while trees with one deformity and those with 3 types occurred with about the same frequency (19.4 and 21.4 percent, respectively). Trees categorized by 4 types of deformity were least abundant (11.4 percent). Most deformities either singly or in combination were infrequent to rare; only 5 types were frequent enough such that further analysis could be made as to their role in height growth loss.

Influence of Deformities

Tree height data for the 5 most frequent deformity categories were averaged and the means compared by an analysis of variance and Scheffe's method at $P < .05$. Mean height (Table 5) fell into 2 distinct classes within which the type of deformity had no significant effect on tree height. Trees with only an aerial crook averaged almost as tall as normal trees. However, trees which possessed a fork were always significantly shorter than those without a fork. Presumably, the multiple terminals compete with each other to restrict overall height growth. If none of these terminals assume apical dominance, height could be curtailed to about half that of normal trees.

CONCLUSIONS

The yellow-poplar plantations surveyed on the Brownstown and Tell City Ranger Districts have been adversely affected by several factors working in combination with the tuliptree scale. These include site limiting factors, such as a high water table and competition from other vegetation, and mechanical damage during planting. These probably accounted for many of the dead trees which averaged one-third of the total stems. However, those trees which survive these factors continue to be adversely affected by high density tuliptree scale populations. The affect of reduced vigor and deformity is expressed as height growth loss which averages nearly half of what a given site is capable. Furthermore, an average of nearly one-fourth of all live trees continue to express low vigor from these scale populations. Also, stem deformities of various types (crook, fork, bush) and in various combinations, occur on about 83 percent of all live stems. Four of 15 possible combinations of the 3 basic types are encountered most frequently (about 46 Percent of the time) and 3 of these (about 35 percent of the time) involve forked tops where 1 or more terminals share apical dominance. Trees with forked tops on the average are about half the total height of normal or non-deformed trees.

MANAGEMENT IMPLICATIONS

From survey observations, it is apparent that the tuliptree scale has an important, but unquantifiable, role in the survival of plantation yellow-poplar trees within the first 15 years of their establishment.

Planting damage and site factors probably are at least as important during this period. Planning and conduct of yellow-poplar plantings must take all these factors into consideration if the original tree stocking is to encourage good form and self-pruning. If these factors are not fully considered, lower stocking with poor formed trees seem inevitable.

Plantation trees which do survive this period often have such low vigor or have been deformed so heavily by tuliptree scale that total height growth may be reduced dramatically. The composite height reduction for all trees sampled was about one-half of the site potential at the end of 15 years. Without scale population reduction, it is doubtful that this height difference can be made up fully through the rotation and almost certain that dbh never will be recovered even though scale populations exert less influence as trees reach pole size. Therefore, a reasonable assumption would be average losses of one-third the merchantable log length and one-fourth the dbh at harvest. Taking the average figures of 70 feet and 18 inches for height and dbh which the Brownstown Ranger District would expect a healthy yellow-poplar to achieve at harvest, the average tree volume would be 331 board feet Scribner. Uncontrolled scale populations would reduce this yield to about 146 board feet Scribner per average tree. Thus, tuliptree scale populations account for about a 56 percent loss in board foot volume. This generally agrees with the economic evaluation assumptions used for the 1982 tuliptree suppression project on the Brownstown Ranger District.

Table 1.--Descriptions of yellow poplar plantations, Wayne-Hoosier
National Forest, Indiana - 1982

Plantation Number	Ranger District/ Compartment/Stand	Year of Origin	Acreage			Survey Date	
			Total	Surveyed (Percent)			
1	Brownstown	54-2	1968	55	0.50	(0.9)	9 MAR 82
2		62-15	1974	10	0.03	(0.3)	18 AUG 82
3		62-34	1974	12	0.13	(1.0)	18 AUG 82
4		63-46	1973	20	0.20	(1.0)	10 MAR 82
5		68-9	1971	22	0.11	(0.5)	18 AUG 82
6		68-11	1971	23	0.11	(0.5)	18 AUG 82
7	Tell City	2-55	1973	44	0.22	(0.5)	11 MAR 82

Table 2.--Characteristics of yellow poplar plantations, Wayne-Hoosier
National Forest, Indiana - 1982

Plantation Number	Average Tree Height (feet)			Tree Density per Acre		
	Sample	Tallest	Ratio	Planted	Current	Percent Occupancy
1	16.3	32.6	0.50	880	458	52.0
2	10.6	15.6	0.68	733	700	95.0
3	5.1	10.6	0.48	846	592	70.0
4	6.7	20.9	0.32	880	420	47.8
5	7.6	16.1.	0.47	900	609	67.6
6	5.7	14.1	0.40	900	427	47.4
7	9.5	22.7	0.42	872	436	50.0

Table 3.--Tree conditions for yellow poplar plantations, Wayne-Hoosier
National Forest, Indiana - 1982

Plantation Number	Tree Status				Total Planting Sites Sampled
	Healthy	Low Vigor	Dead	Missing	
1	27.2	24.8	2.3	45.7	440
2	95.0	0.0	0.0	5.0	22
3	47.3	22.7	0.9	29.1	110
4	21.0	26.8	2.8	49.4	176
5	64.6	3.0	0.0	32.4	99
6	36.4	11.1	0.0	52.6	99
7	36.5	13.5	1.6	48.4	192

Table 4.--Frequency of deformities in yellow poplar plantations, Wayne-Hoosier National Forest, Indiana - 1982

Deformity Categories	Deformity Type	Plantation Number							Total
		1	2	3	4	5	6	7	
----- Percent -----									
None	Normal	14.0	19.0	7.8	15.4	28.2	29.8	16.7	16.7
Single	Basal Crook	6.6	0.0	2.5	14.2	6.0	2.1	2.1	5.8
	Aerial Crook	10.0	33.3	6.5	5.9	19.4	2.1	14.6	11.0
	Fork	1.3	0.0	2.6	1.2	6.0	0.0	1.0	1.8
	Bush	2.2	0.0	0.0	0.0	0.0	0.0	0.0	0.8
Double	Basal Crook/Aerial Crook	5.7	14.3	11.7	17.9	0.0	0.0	4.2	7.1
	Basal Crook/Fork	3.9	4.8	1.3	1.2	1.5	2.1	0.0	2.1
	Basal Crook/Bush	11.8	0.0	5.2	4.8	7.5	21.3	5.2	8.9
	Aerial Crook/Fork	5.2	14.3	20.8	4.8	20.9	19.2	17.7	12.2
	Aerial Crook/Bush	2.2	0.0	0.0	0.0	0.0	0.0	0.0	0.8
	Fork/Bush	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Triple	Basal and Aerial Crook/Fork	6.1	9.5	18.2	26.2	3.0	4.3	16.7	11.6
	Basal and Aerial Crook/Bush	9.6	0.0	6.5	3.6	1.5	8.5	9.4	7.1
	Basal Crook/Fork/Bush	0.9	4.8	1.3	0.0	0.0	0.0	0.0	0.5
	Aerial Crook/Fork/Bush	4.8	0.0	1.3	0.0	0.0	0.0	1.0	2.2
Quadruple	Basal and Aerial Crook/Fork/ Bush	15.7	0.0	14.3	4.8	6.0	10.6	11.4	11.4
----- Number -----									
Total trees sampled		229	21	77	84	67	47	96	621

Table 5.--Mean height growth by deformity class, Wayne-Hoosier National Forest, Indiana - 1982

Class	Deformity Type	Mean Height Growth	Standard Deviation	Sample Size
I	Normal	16.2	11.4	104
	Aerial Crook	14.2	8.4	68
Ti	Aerial Crook/ Fork	8.4	5.5	76
	Basal and Aerial Crook/Fork	6.8	5.5	72
	Basal and Aerial Crook/Fork/Bush	9.0	5.9	71

Tulip Tree Scale Damage Assessment

Field Procedures

Survey Design

Sample one percent of the total stand area with strip cruise lines centered along the plantation rows at random. Trees were Planted in the rows at six foot intervals with eight feet between rows. Each strip plot will be 0.125 x 8 chains (8.25 x 528 feet) which equals 0.1 acre. An estimate of the total trees to be sampled for each of the three most severely infested stands can be computed as tabulated below:

Comp-Stand	Acreage		No. 1/10 Acre Strips	No. Trees Per Acre	Total Trees Sampled
	Total	1% Sample			
54-2	55	0.55	5.5	400	220
63-46	20	0.20	2.0	400	80
68-11	23	0.23	2.5	400	92
	98	0.98			392

Off-set and pick up the remainder of a strip elsewhere if you come to the end of a plantation row.

Observations and Measurements

At six foot intervals from the start of each plot, the following information will be taken for each tree or original planting site for trees which have died: tree number, status, crooks, forks, bush, vigor and height. These data will be recorded on the attached form whose heading will be completed for each strip plot within each stand.

Select the tallest 30 tulip poplar trees in the plantation, measure their total height to the nearest half foot and record on the reverse side of the first plot form. Some of these may already have been recorded.

Definitions

The observation and measurement terms will be defined as follows: Tree Number - Consecutive number with the plot beginning with I.

Status - Coded as L = live, D = dead, M = missing; for the latter two categories go on to the next tree.

Crooks - Trees with a dead terminal at sometime in the past which could be still present or missing but only a single terminal expressing apical dominance now; count number which occur at ground line or above ground and record that number.

Forks - Trees with two or more laterals have formed multiple tops with all these expressing apical dominance; count number of forks and record.

Bush - Trees with two or more stems at ground line and one or all of which have assumed apical dominance; count number of *stems* and record.

Low Vigor - Trees with dead, blackened lower branches comprising a majority of the total branches; observe and record as 0 = NO or 1 .. YES.

Total Height - Height: to tallest live terminal; measure to the nearest half foot and record.

NA

MFO

3460 Technical Assistance

March 25, 1983 (FPM)

Tulip Tree Scale Suppression - Brownstown Ranger District Wayne-
Hoosier National Forest

Staff Director, FPM

The supporting documentation for the above referenced suppression project is enclosed. These include our biological evaluation and the Forest's Project Proposal, (FS 3400-2), Environmental Assessment (WH 1900-1), Economic Evaluation Work Plan (1900-4), Safety Plan (FS 6700-7). Supplemental data collected during our biological evaluation survey, but not reported to the Forest, confirmed their estimate that nearly 4,000 trees should be treated in the 2 plantations.

We have reviewed all documents prepared by the Forest and recommend that funds set aside for this project be transferred to R-9, TM, specifically for this intended use.

ALLAN T. BULLARD Field
Representative Forest Pest
Management

Enclosures
REA/ham

MINI ENVIRONMENTAL ASSESSMENT

The purpose of this assessment is to help accomplish the Forest goals and objectives established by RPA and described in the Forest Land Management Plan.

Tulip Scale Infestation Treatment _____, Wayne-Hoosier National Forest

Brownstown Ranger District Compartment # _____ 62 _____ 21 , ' .3N, 2W
_____ Section __, _____ 3N, R 7w

Decision need:

It is necessary to execute pest management action to prevent an unacceptable level of tulip scale (Toumeyella liriodenri) damage. Tulip scale infestations can, cause growth loss and branch and tree mortality. The terminal shoots of infested trees are often killed, causing crooks which affect the trees' future use for wood products. These tulip plantations total 35 acres and are ten and twelve years of age respectively.

EVALIUTION CRITERIA:

1. Is the intended use compatible with Forest Service Direction and Policy?
2. Will irreparable damage occur to the environment?
3. Is the action socially acceptable?
4. Is the action cost effective?
5. Is the action politically acceptable?
6. Is the action effective in controlling tulip scale infestation?

7.

8

ALTERNATIVES CONSIDERED:

1. No action - allow the tupip scale to progress at a natural rate of spread
2. Treatment with nondermant chemical insecticide
3. Treatment with dormant (oil) insecticide
4. Treatment with tanglefoot

EFFECTS OF IMPLEMENTATION

ELEMENTS	Alternatives				
	1	2	3	4	5
Water	0	0	0	0	
Cultural Resources	0	0	0	0	
Air Quality	0	0	0	0	
Threatened & Endangered Plants & Animals	0	-	0	0	
Visual Resource	-	+	+	+	
Soil	0	0	0	0	
Timber	-	+	+	+	
Wildlife	0	-	0	0	
Social	-	-	0	0	

Explanation of Rating System:

The rating system uses a "+" for favorable effects; a "-" for unfavorable effects, and a "0", showing little or no impact on the element.

Explanation of Rating System: All evaluation criteria are critical and should be

met. Those ranked "1" are most important to the decision while "2" is next in im-

Base for Comparison: Nontreatment of tulip-scale infested tulip poplar plantations.

Comments: In selecting an alternative, only those in which all the evaluation criteria have been positively met may be considered as possible alternatives.

Are there significant effects on the following: (If yes, attach discussion):
 Prime Farmland, Range & Forestland No, Minority Groups, Civil Rights No,
 Unavoidable Adverse Effects No, Irreversible & Irretrievable Resource Commit-
 ments No, and Relationship between short term uses and long term productivity None.

Comments: Without treatment of some sort to control the tulip scale, the investments made on these tulip poplar plantations would be lost due to mortality and growth loss within the plantations.

EVALUATION OF ALTERNATIVES

EVALUATION CRITERIA	RANK	Alternatives				
		1	2	3	4	5
1. Forest Service Policy compatibility	1	No ^{1/}	Yes	Yes	Yes	
2. No irreparable damages to environment	2	Yes	Yes	Yes	Yes	
3. Social acceptability	2	Yes	No	Yes	Yes	
4. Cost effective	2	No ^{2/}	No ^{3/}	Yes	Yes	
5. Political acceptability	3	Yes	Yes	Yes	Yes	
6. Infestation control effectiveness	1	No ^{4/}	Yes	Yes	No ^{4/}	
7.						
8.						

Explanation of Rating System: The rating system uses "yes" to indicate that the alternative meets or satisfies the evaluation criteria, and "no" to indicate that it does not.

Explanation of Ranking System: All evaluation criteria are critical and should be met. Those ranked "1" are most important to the decision while "2" is next in importance, and so on.

Comments: In selecting an alternative, only those in which all the evaluation criteria have been positively met may be considered as possible alternatives.

1/ Alt. #1 is not compatible with Forest Service policy of executing the management objectives on Forest Service land. 2/ Alt. #1 would result in a loss of several acres of tulip plantations and an economic loss. 3/ Chemical treatment is more costly than alternatives 2 and 3. Neither Alt. #1 or Alt. #4 would accomplish control of the infestation. For Tanglefoot (Alt. #4) there is not a sufficient dynamic interaction between predator and prey to benefit from the treatment.

Selected Alternative and Reasoning: Alternative #3 - Treatment with a dormant (oil)
insecticide which contains only oil ingredients is the selected alternative. It
minimizes adverse reactions on non-target organisms while suffocating the tulip scale.
It is also a proven economical alternative.

Management Constraints, Requirements and Mitigating Measures: _____
Timing is a crucial element in application of the dormant oil insecticide. Fall or
Spring treatment are both effective. Application must be accomplished during leaf-off
periods to prevent damage to the foliage. Benefit/cost analysis for this alternative
demonstrates favorable economic efficiency.

An I&I Plan (s) (is not) needed - Attach plan if applicable

Interdisciplinary Team Members: Donald J. Kinerson - Silviculturist

Barbara Tormoehlen - Forester

Gary Peters - Wildlife Biologist

Consultation with Others: Bob Acciavatti - Forest Pest Management, Entomologist
Field Office, Morgantown, WV

The proposed action is in accordance with existing laws, executive orders, regu-
lations, judicial direction and established policy.

There will be no significant effects upon the quality of the human environment.
Therefore, it has been determined that an environmental statement is not needed.

Edward J. Hays, District Ranger for: Forest Supervisor 3/18/83
Signature and Title of Approving Officer Date

ATTACHMENTS: